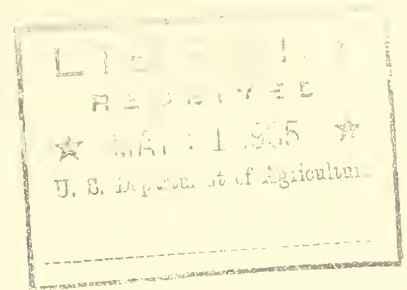


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ELEVEN-MONTH WEATHER SEQUENCES  
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## ELEVEN-MONTH WEATHER SEQUENCES

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Previous studies<sup>1</sup> show that the month of June in Iowa and several other north central states, is a good indicator of the temperature of the next three months and possibly of other months. Because of the need of Iowa agriculture for advance information as to the character of the planting season of 1935, the temperature of June was correlated with the temperature and rainfall of the following May, eleven months later. Including data for June, 1933, and May, 1934, the correlation coefficient for temperature is  $0.333 \pm 0.077$ .

This in itself is not impressive but when a probability curve is worked out as in my paper<sup>2</sup> on "Persistent Weather Abnormality", it shows that the 7 warmest Junes ( $2.8^{\circ}$  or more above normal) have been followed in every case 11 months later by Mays warmer than normal, and that the 4 coolest Junes ( $4.4^{\circ}$  or more below normal) have been followed in every case 11 months later by Mays cooler than normal (fig. 1). The study was extended into several central states to determine, if possible, the metes and bounds of this relationship. Figure 2 shows that it is strongest in Minnesota where with June temperature only  $1^{\circ}$  above normal, the following May is above normal in 14 out of 15 cases, or 93% of the time; and when only  $0.5^{\circ}$  above normal, May was warmer than normal in 16 out of 17 cases, or 94%.

Raising the June departure to  $5^{\circ}$  or more above normal, increases the probability of a warm May to 100% over an area that includes most of the Missouri and upper and middle Mississippi valleys as shown in fig. 3. This works similarly with June temperatures below normal indicating cool Mays 11 months hence. At  $5^{\circ}$  or more below normal, cool Mays are 100% probable over much the same area. The correlation dot chart for Minnesota is shown by figure 4. "The greater the abnormality, the more certain the sequence", seems to work equally as well in this remote relationship as it does in those closer relationships that can be regarded as "persistent abnormality" even though the abnormality, at its peak in June, may disappear or be reversed in one or more intervening months of the 11-month period.

So much for a mid-continental area subject to all the temperature vagaries resulting from overlapping influences of the Rocky Mountains, the Gulf of Mexico, the Great Lakes and the Arctic region. A mid-oceanic situation was sought with the hope that the total number of influences would be less and that the weather relationships and sequences might be more simple.

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<sup>1</sup>Monthly Weather Review, June, 1925, p.p. 249-251.

<sup>2</sup>Monthly Weather Review, April, 1933, p.p. 109-112.



This quest was successful. On the little Island of Bermuda, a mere dot of land 700 miles east of the Atlantic Coast of the United States, the temperatures of June, July, August and possibly other months show striking plus correlations with the temperatures 11 months later. The most outstanding of these is July temperature with the following June temperature, the correlation coefficient for which is +0.631 which is nearly 13 times the probable error (fig. 5). Yet the most outstanding probability is that the 18 warmest Junes ( $0.9^{\circ}$  or more above normal) were followed in every case 11 months later by Mays above normal in temperature and that the 19 coolest Junes ( $1.0^{\circ}$  or more below normal) were followed by cool Mays 17 times or a probability of 89%, increasing to 100% when June is  $3.0^{\circ}$  below normal. Augusts, even as little as  $0.1^{\circ}$  below normal in temperature were followed 11 months later by Julys below normal 27 out of 33 times, or a probability of 82%, increasing to 100% when August was  $2.5^{\circ}$  below normal.

All of these things suggest an 11-month temperature cycle, but in the mid-continental climate it is more or less obliterated by complexities of topography, land and water.

One of the peculiar things is that the abnormalities and 11-month sequences do not fall in the same years in Bermuda as they do in Minnesota nor has it been possible to find a lag or acceleration by which Bermuda and Minnesota can be correlated. It seems likely that such a relationship exists but is somehow obscured. Another peculiarity is that between the mid-continental and the mid-oceanic region there is a large area from the Appalachian Mountains to the coast that is neutral and shows no such 11-month sequences.

Another peculiarity is that at Alma Ata, Siberia, near the middle of the vast Eurasian Continent, the 11-month relationship has a strongly negative correlation coefficient. There, for example, a warm June is followed by a cool May, exactly the reverse of Minnesota and Bermuda. Honolulu in the mid-Pacific shows the same tendency to the 11-month sequence as Bermuda but not so marked, probably because it has more of the tropical type of climate.

June, 1934, was unusually warm in most of the mid-west states. The temperature departures (all plus) for each of these midwest states is shown by fig. 6. These departures were compared with the probability curves for each State and the percent of probability that May, 1935, temperatures will be above normal is shown by fig. 7, and the probability that May will be drier than normal is shown by fig. 8. As May draws nearer, there are other months that may become good indicators if they



have large departures from normal temperature. A very cold December indicates a warm May and a cool April indicates a dry May, but the current data for these months are of course not available when this paper is being written.

Copious precipitation in the fall of 1934 in Iowa saturated the soil to considerable depth, starting tile drains and small streams running, and filling ponds. A moderately warm, dry, May in 1935 is more likely to be beneficial than otherwise, promoting planting and preparation for planting corn, Iowa's principal crop. The regression formula for May temperature from June temperature is

$$Y = 0.41X + 31.5$$

in which Y is the required May temperature and X is the average temperature of the preceding June. This gives for May, 1935, an average temperature for Iowa of 63.2°, or 2.1° above normal which if approximately realized will start the 1935 corn season very satisfactorily. It is almost certain that the record breaking high temperatures of May, 1934, will not be repeated.



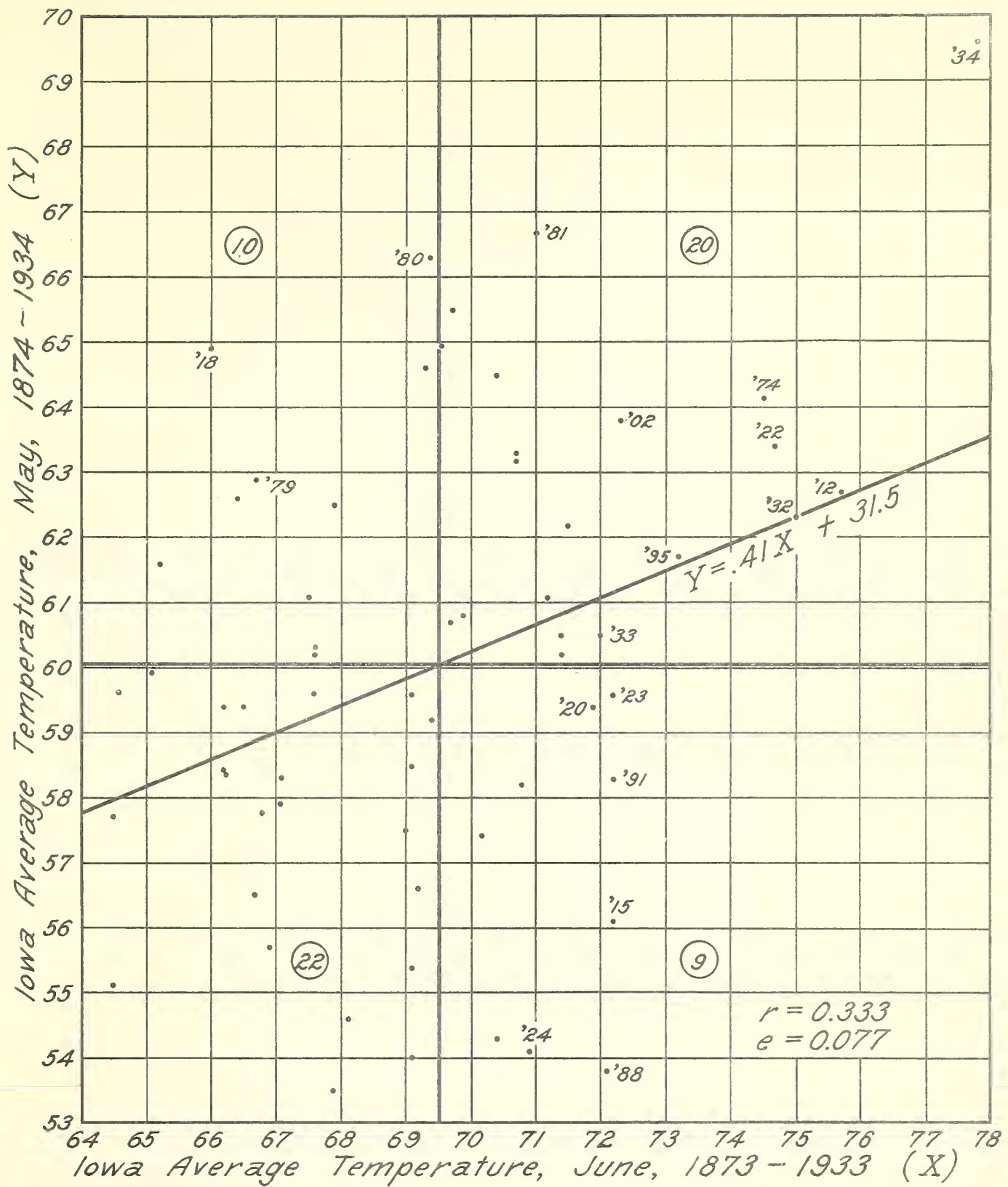


Figure 1.



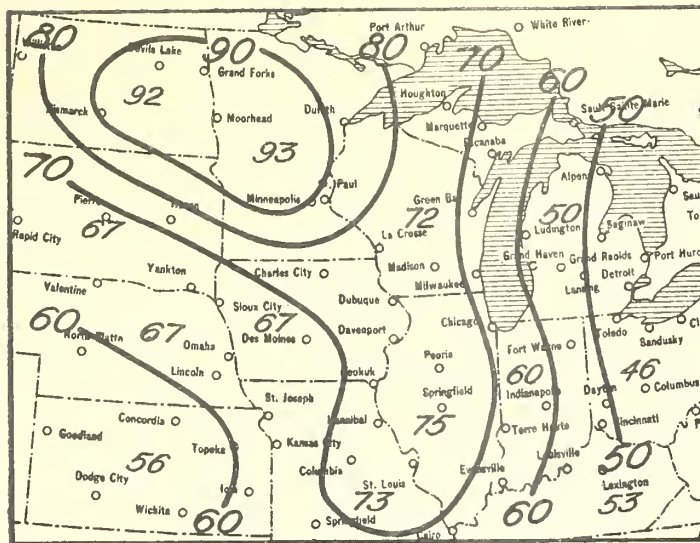


Fig.2.—Figures near the center of each State show the percentage frequency that May temperature above normal follows June, 11 months previous, 1° or more above normal.

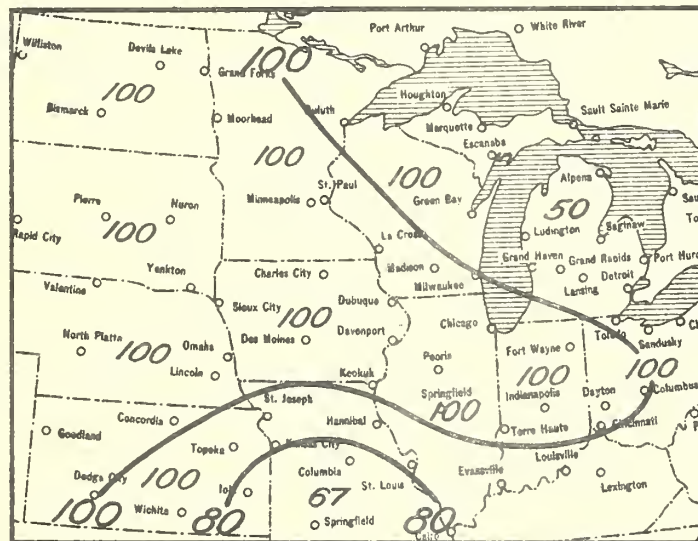


Fig.3.—Figures near the center of each State show the percentage frequency that May temperature above normal follows June, 11 months previous, 5° or more above normal.



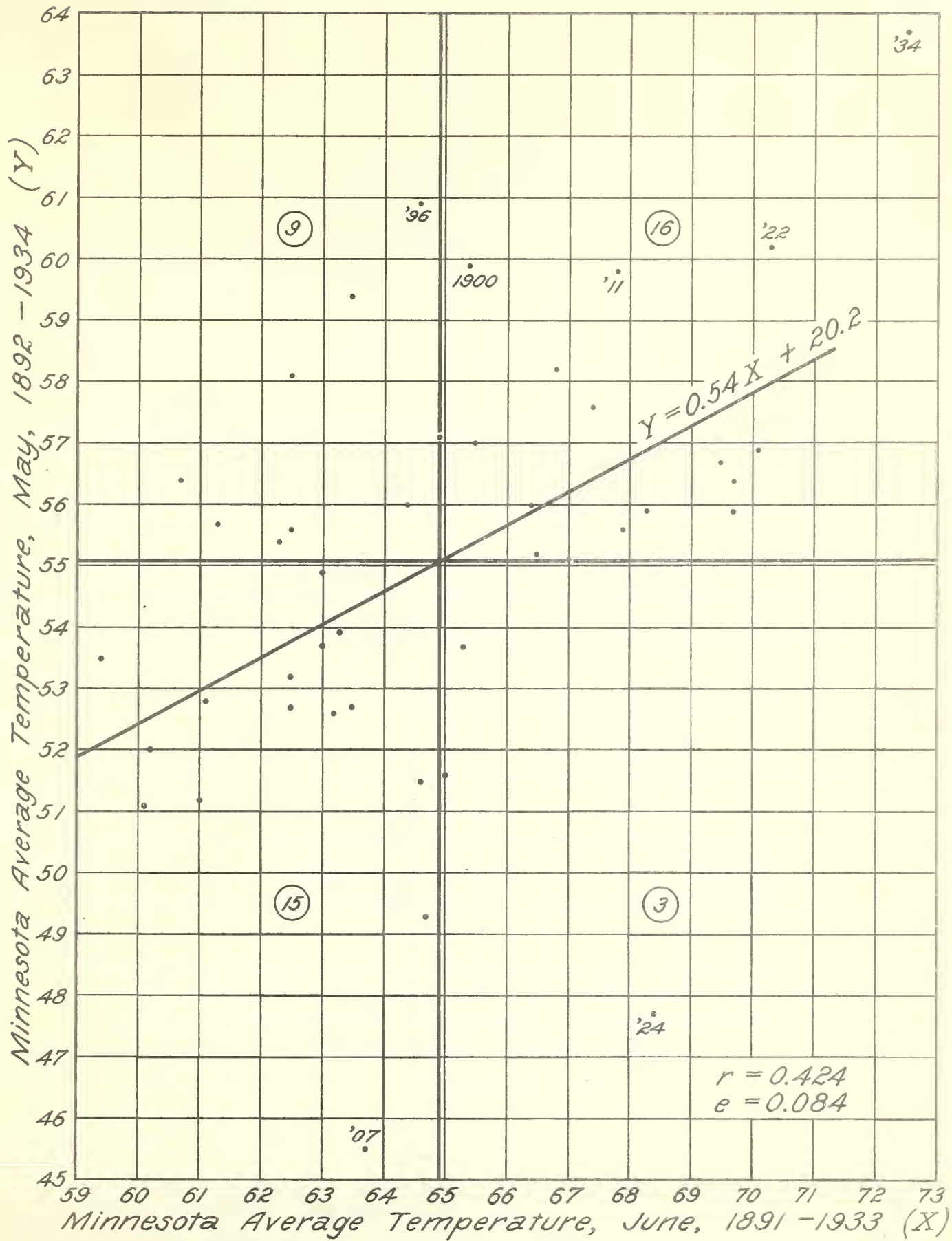


Figure 4.



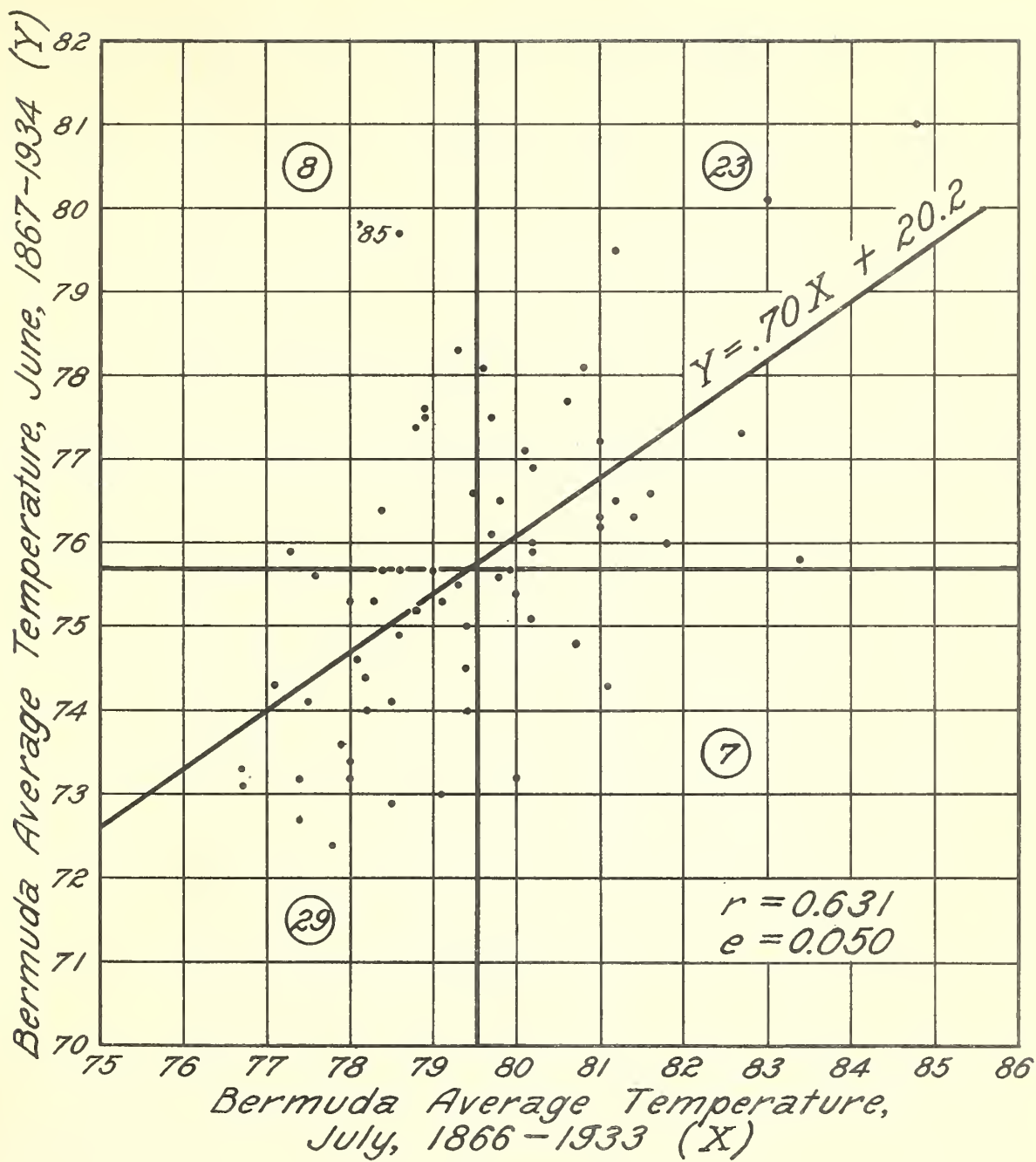


Figure 5.



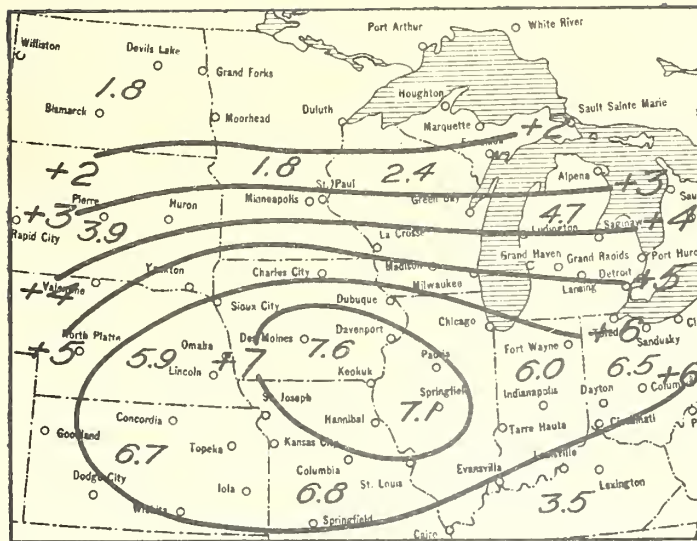


Fig.6.— Figures near the center of each State show the departure from normal temperature, June, 1934 (all plus).

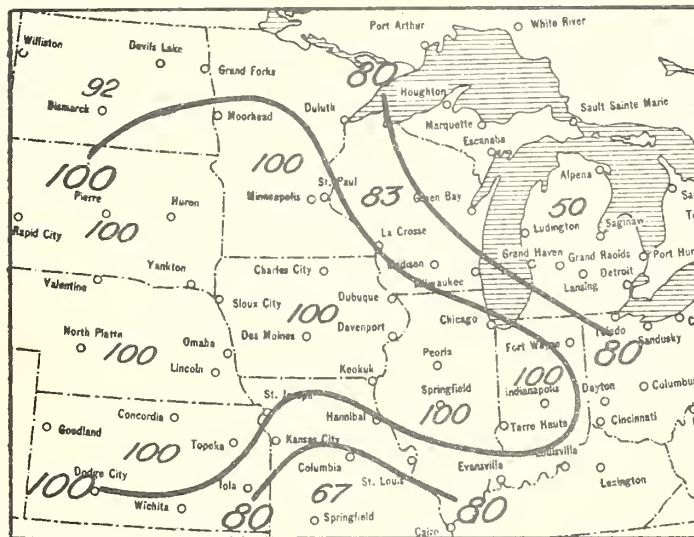


Fig.7. - Figures near the center of each State show the percentage probability that May, 1935, temperatures will be above normal.



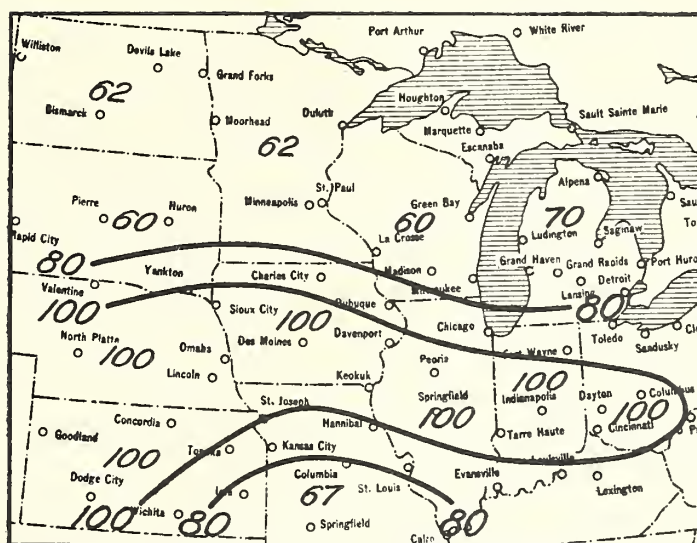


Fig.8. - Figures near the center of each State show the percentage of probability that May, 1935, will be drier than normal.

